Cognitively-modulated Risk Aversion in Human Decision-making

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Prospect theory has long been one of the standard protocols for behavioral economics. The key concept of risk aversion has been used to explain a wide variety of economic phenomena. However, recent evidence has shown that feedback-driven learning could lead to an unexpected reversal of risk aversion. Furthermore, cognitive loads and functions have also been reported to influence risk aversion. All of the above raises the question of whether risk aversion, which has been regarded as a macroscopic human attitude, could be governed by some underlying cognitive processes in relevant neural substrates such as the prefrontal cortex and striatum.

In our study, we address this possibility by systematically simulating two risky decision-making paradigms, using computational models of reinforcement learning. In a gain-loss selection task (GLT), the reversal of risk aversion has been successfully replicated with a larger utility curvature (uc ~ 0.8) combined with learning effects. Conversely, in a classic Iowa gambling task (IGT), a smaller utility curvature (uc ~ 0.2) is necessary to capture subjects' deck preference attributed to the frequency effect of reinforcements. Furthermore, the gap of utility curvatures between GLTs and IGTs could be explained by the intrinsic difference of cognitive loads, which supports our hypothesis that risk aversion could result from cognitive modulation of limited processing resources in face of various nature of reinforcements. This cognitive view of risk aversion could further imply a potentially modulatory role of the prefrontal cortex in the magnitude-frequency computation of striatum.

Keywords: risk aversion, utility curvature, cognitive load, reinforcement learning

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